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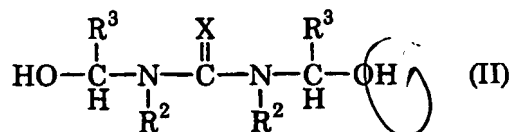
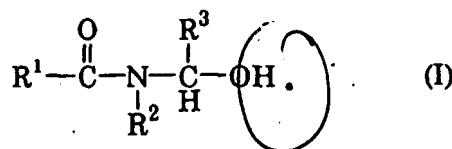
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**(54) PHOTORESIST STRIPPER COMPOSITION**

(57) The photoresist stripping composition of the present invention comprises an amine compound and at least one alkanol amide compound selected from the group consisting of compounds represented by Formula I or II:



wherein R<sup>1</sup>, R<sup>2</sup> and R<sup>3</sup> are the same as defined in the specification, and polymers of the compounds of Formula I wherein R<sup>1</sup> is alkenyl group. By using the photoresist stripping composition, the photoresist film remaining after dry etching and the resist residue after ashing can be quite easily removed without corroding the wiring material, etc.

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**Description**Technical Field

5 [0001] The present invention relates to a photoresist stripping composition for use in the wiring-forming process or electrode-forming process for producing semiconductor elements of semiconductor integrated circuits or liquid crystal displays, and relates to a process of producing semiconductor elements using the photoresist stripping composition.

Background Art

10

[0002] Semiconductor integrated circuits have been generally produced by the steps of coating a photoresist composition onto a wiring thin film formed on an inorganic substrate to form a photoresist film; patterning the photoresist film by exposure to light and subsequent development to form a photoresist pattern; etching non-masked portions of the wiring thin film using the photoresist pattern as a mask to form fine circuits; and removing the photoresist film from the inorganic substrate having formed thereon the fine circuits. Alternatively, after forming the fine circuits in the same manner, the photoresist film is ashed and the remaining resist residues are removed from the inorganic substrate having formed thereon the fine circuits.

15 [0003] Japanese Patent Application Laid-Open Nos. 62-49355, 62-95531 and 5-273768 disclose water-free, organic amine-based stripping agents. However, the proposed organic amine-based stripping agents are extremely poor in the removing ability of the resist film after etching and the resist residue after etching/ashing.

20 [0004] Under the recent requirement for ultrafine circuits, the wiring materials are etched under more severe conditions, this being likely to change the quality of the photoresist being used. Also, the resist residue after etching/plasma ashing has a complicated chemical composition. Therefore, the proposed organic amine-based stripping agents have been found to be less effective for removing such resist films and resist residues.

25 [0005] In a dry etching, sidewall polymers, a kind of resist residues, are formed on the sidewall of etched portions by the interaction between dry etching gas, resist materials and various wiring materials. The known organic amine-based stripping agents mentioned above are also less effective for removing the sidewall polymers.

[0006] Japanese Patent Application Laid-Open Nos. 64-81949, 64-81950 and 6-266119 disclose water-containing, alkanol amine-based stripping agents. However, these water-containing, alkanol amine-based stripping agents are still insufficient for removing the above resist films, resist residues and sidewall polymers.

30 [0007] The semiconductor elements for semiconductor integrated circuits and liquid crystal displays are recently made of various materials. Therefore, a photoresist stripping agent that does not corrode the inorganic substrate and wiring that are made of various materials have been demanded to be developed.

35 Disclosure of Invention

[0008] An object of the present invention is to solve the above problems in the conventional stripping agents, and to provide a resist stripping composition that is capable of easily removing photoresist films coated on a wiring thin film formed on an inorganic substrate, photoresist films remaining after etching the wiring thin film, and photoresist residues remaining after etching and subsequent ashing, at low temperatures in a short period of time without corroding the inorganic substrate and wiring made of various inorganic materials, thereby ensuring the fine processing for forming high precision circuits.

40 [0009] As a result of extensive researches in view of the above objects, the inventors have found a photoresist stripping composition that is capable of removing photoresist masks and resist residues remaining after etching and resist residues remaining after etching and subsequent ashing easily in a short period of time without corroding wiring and insulating film formed on an inorganic substrate, thereby ensuring the production of semiconductor fine circuits with a high precision. The present invention has been accomplished based on this finding.

45 [0010] Thus, the present invention provides a photoresist stripping composition comprising an amine compound and an alkanol amide compound having a specific structure. The photoresist stripping composition may further contain at least one of an organic solvent, an anti-corrosion agent and water.

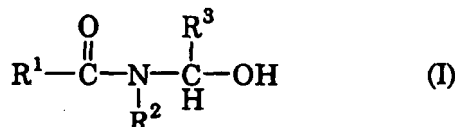
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Brief Description of Drawings

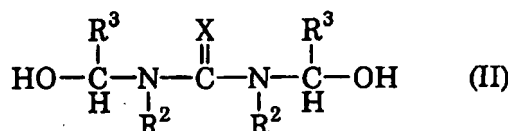
55 [0011] Fig. 1 is a partial cross-sectional view showing a semiconductor device obtained by forming Al-alloy wiring by dry etching using a resist film as a mask, and then, ashing by oxygen plasma.

## Best Mode for Carrying Out the Invention

[0012] The alkanol amide compound used in the present invention has an alkanol residue (-CR<sup>3</sup>H-OH) together with an amide linkage (-CON-) or a thioamide linkage (-CSN-) as shown by Formula I:



wherein R<sup>1</sup> is hydrogen, alkyl group, hydroxyalkyl group, alkenyl group, aryl group, or amino group; R<sup>2</sup> is hydrogen, alkyl group, hydroxyalkyl group, aryl group, or allyl group; R<sup>3</sup> is hydrogen, alkyl group or hydroxyalkyl group; with the proviso that R<sup>1</sup> and R<sup>2</sup> together with the amide linkage may form a ring structure when R<sup>1</sup> and R<sup>2</sup> are both alkyl groups, or shown by Formula II:



wherein R<sup>2</sup> is hydrogen, alkyl group, hydroxyalkyl group, aryl group, or allyl group; R<sup>3</sup> is hydrogen, alkyl group or hydroxyalkyl group; and X is O or S.

[0013] The alkanol compound may include a polymer of the compound represented by Formula I wherein R<sup>1</sup> is alkenyl group.

[0014] One or more alkanol amide structures in one molecule are enough for the purpose, and two or more alkanol amide structures cause no adverse effect.

[0015] The chain or cyclic alkyl group represented by R<sup>1</sup> is preferably a chain or cyclic C1-C12 alkyl group, and more preferably methyl, ethyl, n-propyl, isopropyl, n-butyl, isobutyl, t-butyl, or cyclohexyl. The hydroxyalkyl group represented by R<sup>1</sup> is preferably hydroxy(C1-C10 alkyl), and more preferably 1-hydroxyethyl, 2-hydroxypropyl, hydroxymethyl, 2-hydroxyethyl, or 1-hydroxy-1-methylethyl. The alkenyl group represented by R<sup>1</sup> is preferably a chain or cyclic C2-C10 alkenyl, and more preferably vinyl, 1-methylvinyl, allyl, methallyl, or cyclohexenyl. The aryl group represented by R<sup>1</sup> is preferably phenyl, naphthyl, hydroxyphenyl, tolyl, or pyridyl. The amino group represented by R<sup>1</sup> is preferably amino, aminomethyl, 1-aminoethyl, 2-aminoethyl, methylamino or dimethylamino.

[0016] The alkyl group, hydroxyalkyl group and aryl group represented by R<sup>2</sup> are the same as described with respect to R<sup>1</sup>.

[0017] The alkyl group and hydroxyalkyl group represented by R<sup>3</sup> are the same as described with respect to R<sup>1</sup>.

[0018] Examples of the alkanol amide compounds include N-methylol acetamide, N-methylol formamide, N-(1-hydroxyethyl) acetamide, N-(1-hydroxyethyl) formamide, N-methylol urea, N,N'-dimethylol urea, N-methylol acrylamide, N-methylol methacrylamide, N-methyl-N-hydroxymethyl acetamide, N-ethyl-N-hydroxymethyl acetamide, N-methyl-N-hydroxymethyl formamide, N-ethyl-N-hydroxymethyl formamide, N,N-dihydroxymethyl formamide, N,N-dihydroxymethyl acetamide, methylol stearylamine, methylol thiourea, methylol pyrrolidone, N-methylol lactamide, N-methylol-2-hydroxy-2-methyl propylamide, N-(1-hydroxyethyl) acrylamide, N-(1-hydroxyethyl) methacrylamide, N-methylol propionamide, poly(acrylamide methylol) (polymer of N-methylol acrylamide), and poly(methacrylamide methylol) (polymer of N-methylol methacrylamide).

[0019] The alkanol amide compound is not limited to the above examples, and a compound having at least one alkanol amide structure is equally usable in the present invention. Many of the alkanol amide compounds of Formula I or II wherein R<sup>3</sup> is hydrogen or methyl are conventionally produced and preferable in view of easy availability.

[0020] The amine compound usable may include, for example, an alkylamine, an alkanolamine, a polyamine, a hydroxylamine compound and a cyclic amine.

[0021] Examples of the alkyl amines include primary alkylamines such as methylamine, ethylamine, n-propylamine, isopropylamine, n-butylamine, ~~sec-butylamine~~, isobutylamine, t-butylamine, pentylamine, 2-aminopentane, 3-aminopentane, 1-amino-2-methylbutane, 2-amino-2-methylbutane, 3-amino-2-methylbutane, 4-amino-2-methylbutane, hexylamine, 5-amino-2-methylpentane, heptylamine, octylamine, nonylamine, decylamine, undecylamine, do-

decylamine, tridecylamine, tetradecylamine, pentadecylamine, hexadecylamine, heptadecylamine, and octadecylamine; secondary alkylamines such as dimethylamine, diethylamine, dipropylamine, diisopropylamine, dibutylamine, diisobutylamine, di-sec-butylamine, di-t-butylamine, dipentylamine, dihexylamine, diheptylamine, dioctylamine, dinonylamine, didecylamine, methylethylamine, methypropylamine, methylisopropylamine, methylbutylamine, methylisobutylamine, methyl-sec-butylamine, methyl-t-butylamine, methylamylamine, methylisoamylamine, ethylpropylamine, ethylisopropylamine, ethylbutylamine, ethylisobutylamine, ethyl-sec-butylamine, ethyl-t-butylamine, ethylisoamylamine, propylbutylamine, and propylisobutylamine; and tertiary alkylamines such as trimethylamine, triethylamine, tripropylamine, tributylamine, tripentylamine, dimethylethylamine, methyl-diethylamine, and methyl-dipropylamine.

**[0022]** Examples of the alkanolamines include ethanolamine, N-methylethanolamine, N-ethylethanolamine, N-propylethanolamine, N-butylethanolamine, diethanolamine, isopropanolamine, N-methylisopropanolamine, N-ethylisopropanolamine, N-propylisopropanolamine, 2-aminopropane-1-ol, N-methyl-2-aminopropane-1-ol, N-ethyl-2-aminopropane-1-ol, 1-aminopropane-3-ol, N-methyl-1-aminopropane-3-ol, N-ethyl-1-aminopropane-3-ol, 1-aminobutane-2-ol, N-methyl-1-aminobutane-2-ol, N-ethyl-1-aminobutane-2-ol, 2-aminobutane-1-ol, N-methyl-2-aminobutane-1-ol, N-ethyl-2-aminobutane-1-ol, 3-aminobutane-1-ol, N-methyl-3-aminobutane-1-ol, N-ethyl-3-aminobutane-1-ol, 1-aminobutane-4-ol, N-methyl-1-aminobutane-4-ol, N-ethyl-1-aminobutane-4-ol, 1-amino-2-methylpropane-2-ol, 2-amino-2-methylpropane-1-ol, 1-aminopentane-4-ol, 2-amino-4-methylpentane-1-ol, 2-amino-4-methylpentane-1-ol, 3-aminoheptane-4-ol, 1-aminooctane-2-ol, 5-aminooctane-4-ol, 1-aminopropane-2,3-diol, 2-aminopropane-1,3-diol, tris(oxyethyl)aminomethane, 1,2-diaminopropane-3-ol, 1,3-diaminopropane-2-ol, and 2-(2-aminoethoxy)ethanol.

**[0023]** Examples of the polyamines include ethylenediamine, propylenediamine, trimethylenediamine, tetramethylenediamine, 1,3-diaminobutane, 2,3-diaminobutane, pentamethylenediamine, 2,4-diaminopentane, hexamethylenediamine, heptamethylenediamine, octamethylenediamine, nonamethylenediamine, N-methylethylenediamine, N,N-dimethylethylenediamine, trimethylethylenediamine, N-ethylethylenediamine, N,N-diethylethylenediamine, triethylethylenediamine, 1,2,3-triaminopropane, hydrazine, tris(2-aminoethyl)amine, tetra(aminomethyl)methane, diethylenetriamine, triethylenetetramine, tetraethylenepentamine, heptaethylenoetamine, and nonaethylenedecamine.

**[0024]** Examples of the hydroxylamine compounds include hydroxylamine, N-methylhydroxylamine, N-ethylhydroxylamine, and N,N-diethylhydroxylamine.

**[0025]** Examples of the cyclic amines include pyrrole, 2-methylpyrrole, 3-methylpyrrole, 2-ethylpyrrole, 3-ethylpyrrole, 2,3-dimethylpyrrole, 2,4-dimethylpyrrole, 3,4-dimethylpyrrole, 2,3,4-trimethylpyrrole, 2,3,5-trimethylpyrrole, 2-pyrroline, 3-pyrroline, pyrrolidine, 2-methylpyrrolidine, 3-methylpyrrolidine, pyrazole, imidazole, 1,2,3-triazole, 1,2,3,4-tetrazole, piperidine, 2-pipecoline, 3-pipecoline, 4-pipecoline, 2,4-lupetidine, 2,6-lupetidine, 3,5-lupetidine, piperazine, 2-methylpiperazine, 2,5-dimethylpiperazine, 2,6-dimethylpiperazine, and morpholine.

**[0026]** The amine compound usable in the present invention is not limited to the amines recited above, and any amine compounds are usable without specific limitation. The amine compounds may be used singly or in combination of two or more.

**[0027]** Of the amine compounds recited above, preferred are methylamine, ethylamine, propylamine, butylamine, ethanolamine, N-methylethanolamine, N-ethylethanolamine, diethanolamine, isopropanolamine, 2-(2-aminoethoxy)ethanol, ethylenediamine, propylenediamine, butylenediamine, diethylenetriamine, piperazine, and morpholine.

**[0028]** The organic solvent usable in the present invention is not specifically limited as far as miscible with a mixture of the alkanol amide compound and the amine compound, and preferably a water-soluble organic solvent.

Examples thereof include ether solvents such as ethylene glycol, ethylene glycol monoethyl ether, ethylene glycol monobutyl ether, diethylene glycol monomethyl ether, diethylene glycol monoethyl ether, diethylene glycol monobutyl ether, propylene glycol monomethyl ether, propylene glycol monoethyl ether, propylene glycol monobutyl ether, dipropylene glycol monomethyl ether, dipropylene glycol monoethyl ether, dipropylene glycol monobutyl ether, diethylene glycol dimethyl ether and dipropylene glycol dimethyl ether; amide solvents such as formamide, monomethylformamide, dimethylformamide, monoethylformamide, diethylformamide, acetamide, monomethylacetamide, dimethylacetamide, monoethylacetamide, diethylacetamide, N-methylpyrrolidone and N-ethylpyrrolidone; alcohol solvents such as methyl alcohol, ethyl alcohol, isopropanol, ethylene glycol and propylene glycol; sulfoxide solvents such as dimethyl sulfoxide; sulfone solvents such as dimethyl sulfone, diethyl sulfone, bis(2-hydroxy) sulfone and tetramethylene sulfone; imidazolidinone solvents such as 1,3-dimethyl-2-imidazolidinone, 1,3-diethyl-2-imidazolidinone and 1,3-diisopropyl-2-imidazolidinone; and lactone solvents such as γ-butyrolactone and δ-valerolactone.

**[0029]** Of the above solvents, preferred are dimethyl sulfoxide, N,N-dimethylformamide, N,N-dimethylacetamide, N-methylpyrrolidone, diethylene glycol monomethyl ether, diethylene glycol monobutyl ether, dipropylene glycol monomethyl ether and dipropylene glycol monobutyl ether.

**[0030]** The photorealist stripping composition of the present invention may further contain an anti-corrosion agent. Examples thereof include phosphoric acid compounds such as 1,2-propanediaminetetramethylene phosphonic acid and hydroxyethane phosphonic acid; carboxylic acids such as ethylenediaminetetraacetic acid, dihydroxyethylglycine, nitrilotriacetic acid, oxalic acid, citric acid, malic acid and tartaric acid; amines such as bipyridine, tetraphenylporphyrin,

phenanthroline and 2,3-pyridinediol; oxime compounds such as dimethylglyoxime and diphenylglyoxime; sugar alcohols such as sorbitol and xylitol; aromatic hydroxy compounds such as phenol, cresol, xylenol, pyrocatechol, resorcinol, hydroquinone, pyrogallol, 1,2,4-benzenetriol, salicyl alcohol, p-hydroxybenzyl alcohol, o-hydroxybenzyl alcohol, p-hydroxyphenetyl alcohol, p-aminophenol, m-aminophenol, diaminophenol, aminoresorcinol, p-hydroxybenzoic acid, o-hydroxybenzoic acid, 2,4-dihydroxybenzoic acid, 2,5-dihydroxybenzoic acid, 3,4-dihydroxybenzoic acid, 3,5-dihydroxybenzoic acid and gallic acid.

[0031] These compounds may be used alone or in combination of two or more. Preferred anti-corrosion agent is the aromatic hydroxy compound, and catechol is more preferred in view of its low cost.

[0032] The mixing ratio (weight ratio) of the alkanol amide compound is 0.0001 to 50, preferably 0.005 to 20 based on the amine compound. The concentration of the amine compound in the photoresist stripping composition is 2 to 99.99% by weight, preferably 5 to 95% by weight.

[0033] The use of the organic solvent is not strictly limited. The concentration thereof can be determined depending on the viscosity and specific gravity of the photoresist stripping composition and the conditions of etching process and ashing process. If used, the concentration thereof may be up to 90% by weight of the photoresist stripping composition.

[0034] The addition amount of the anti-corrosion agent is not specifically limited, and preferably 30% by weight or less, more preferably 15% by weight or less of the photoresist stripping composition.

[0035] The photoresist stripping composition may further contain water. The addition amount of water is not specifically limited and may be determined depending on the etching conditions and ashing conditions. Preferably, the addition amount of water is 50% by weight or less of the photoresist stripping composition.

[0036] The inorganic substrate usable in the present invention may include silicon, amorphous silicon, polysilicon, and glass substrate for liquid crystal display. The wiring material may include semiconductor wiring materials such as silicon oxide, silicon nitride, copper, copper alloys, aluminum, aluminum alloys, titanium, titanium-tungsten, titanium nitride, tungsten, tantalum, tantalum compounds, chromium, chromium oxide, chromium alloys, indium-tin-oxide (ITO); and compound semiconductors such as gallium-arsenic, gallium-phosphorus and indium-phosphorus.

[0037] In the production method of a semiconductor element of the present invention, an inorganic substrate is provided thereon with a conductive thin film for circuits, which is then coated with a photoresist composition. The formed photoresist film is patterned by exposure to light. The non-masked portions of the conductive thin film is etched using the patterned photoresist film as a mask. Then, the remaining photoresist film is removed by the photoresist stripping composition mentioned above. After the etching, the ashing treatment may be employed, if desired. The photoresist residue remaining after the ashing treatment can be also removed by the photoresist stripping composition. The ashing treatment referred to herein is a resist removing method in which a photoresist made of an organic polymer is vaporized to CO and CO<sub>2</sub> by combustion in oxygen plasma.

[0038] The removal of the remaining photoresist film and photoresist residue by the photoresist stripping composition of the present invention is carried out by contacting the inorganic substrate having the remaining photoresist film and photoresist residue with the photoresist stripping composition at a temperature usually from ordinary temperature to 150°C. To prevent the materials for semiconductor elements from being attacked, the contacting operation is preferably carried out at a temperature as low as possible. By using the photoresist stripping composition of the present invention, the remaining photoresist film and photoresist residue can be removed at low temperatures, particularly, at 70°C or lower. The contacting operation is carried out by spray, application or immersion. The contacting time is preferably 0.5 to 60 min.

[0039] After removal using the photoresist stripping composition, the inorganic substrate having formed thereon circuits may be rinsed with an organic solvent such as alcohol or water, without specific limitation.

[0040] The present invention will be described in more detail with reference to the following examples. However, it should be noted that the scope of the present invention is not limited to the following examples.

[0041] In Fig. 1, is shown a partial cross-sectional view of a semiconductor device that is obtained by forming Al-alloy (Al-Cu) wiring 5 by dry etching using a photoresist film as a mask, and then, ashing by oxygen plasma. An oxide film 2 is formed on a silicon substrate 1, and the Al-alloy film 5 serving as wiring is formed on the oxide film 2. On the sidewalls of the Al-alloy film 5, a resist residue 7 remains. A titanium film 3 and titanium nitride films 4, 6 are further formed as barrier metals.

#### EXAMPLES 1-12 AND COMPARATIVE EXAMPLES 1-3

[0042] The semiconductor device having the resist residue as shown in Fig. 1 was immersed in the photoresist stripping composition having each chemical composition shown in Tables 1-4 in a predetermined period of time, rinsed with a super pure water, dried, and then observed under a scanning electron microscope (SEM). The removal of the remaining photoresist film and resist residue, and the corrosion of the aluminum (Al) wiring were evaluated. The results are shown in Table 1-4. In the following examples and comparative examples, the results of SEM observation was evaluated according to the following ratings.

## Removal

## [0043]

- 5        A: Completely removed.  
        B: Almost completely removed.  
        C: Partially remained unremoved.  
        D: Almost all remained unremoved.

## 10    Corrosion

## [0044]

- 15       A: No corrosion was observed.  
        B: Almost no corrosion was observed.  
        C: Crater-like or pit-like corrosion was observed.  
        D: Whole surface of aluminum wiring was roughened, and Al-Cu layer was recessed.

Table 1

|  | EXAMPLES      |               |               |               |
|--|---------------|---------------|---------------|---------------|
|  | 1             | 2             | 3             | 4             |
| Amine  |               |               |               |               |
| kind   | ethanol amine | ethanol amine | ethanol amine | ethanol amine |
| concentration (wt %)   | 70            | 78            | 78            | 75            |
| Alkanol amide  |               |               |               |               |
| kind*  | MLAD          | MLAD          | MLFD          | MLAD          |
| concentration (wt %)   | 3             | 5             | 5             | 8             |
| Organic solvent  |               |               |               |               |
| kind*  | DMSO          | -             | -             | -             |
| concentration (wt %)   | 27            | -             | -             | -             |
| Anti-corrosion agent   |               |               |               |               |
| kind   | -             | catechol      | catechol      | catechol      |
| concentration (wt %)   | -             | 5             | 5             | 5             |
| H <sub>2</sub> O   |               |               |               |               |
| concentration (wt %)   | -             | 12            | 12            | 12            |
| Stripping conditions   |               |               |               |               |
| temperature (°C)   | 55            | 55            | 55            | 55            |
| time (min)   | 10            | 3             | 3             | 5             |
| Stripping  | A             | A             | A             | A             |
| Corrosion  | A             | A             | A             | A             |
| Note: MLAD = N-methylol acetamide<br>MLFD = N-methylol formamide<br>DMSO = dimethylsulfoxide |               |               |               |               |

Table 2

|                      | EXAMPLES      |               |                  |                       |
|----------------------|---------------|---------------|------------------|-----------------------|
|                      | 5             | 6             | 7                | 8                     |
| Amine                |               |               |                  |                       |
| kind                 | ethanol amine | ethanol amine | ethylene diamine | N-methyl ethanolamine |
| concentration (wt %) | 75            | 65            | 50               | 78                    |
| Alkanol amide        |               |               |                  |                       |

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Table 2 (continued)

|  | EXAMPLES |          |      |          |
|--|----------|----------|------|----------|
|  | 5        | 6        | 7    | 8        |
| kind*  | HEAD     | MLAD     | MLAD | MLAD     |
| concentration (wt %)   | 8        | 5        | 5    | 5        |
| Organic solvent  |          |          |      |          |
| kind*  | -        | DGBE     | DGBE | -        |
| concentration (wt %)   | -        | 15       | 30   | -        |
| Anti-corrosion agent   |          |          |      |          |
| kind   | catechol | catechol | EDTA | catechol |
| concentration (wt %)   | 5        | 3        | 3    | 5        |
| H <sub>2</sub> O   |          |          |      |          |
| concentration (wt %)   | 12       | 12       | 12   | 12       |
| Stripping conditions   |          |          |      |          |
| temperature (°C)   | 55       | 55       | 50   | 55       |
| time (min)   | 5        | 5        | 3    | 10       |
| Stripping  | A        | A        | A    | A        |
| Corrosion  | A        | A        | A    | A        |
| Note: HEAD = N-(1-hydroxyethyl) acetamide<br>MLAD = N-methylol acetamide<br>DGBE = diethylene glycol monobutyl ether<br>EDTA = ethylenediaminetetraacetic acid |          |          |      |          |

Table 3

|   | EXAMPLES      |               |               |               |
|---|---------------|---------------|---------------|---------------|
|   | 9             | 10            | 11            | 12            |
| Amine   |               |               |               |               |
| kind  | ethanol amine | ethanol amine | ethanol amine | ethanol amine |
| concentration (wt %)  | 65            | 40            | 73            | 65            |
| Alkanol amide   |               |               |               |               |
| kind*   | MLAD          | HEAD          | HEAD          | HEAD          |
| concentration (wt %)  | 5             | 5             | 10            | 5             |
| Organic solvent   |               |               |               |               |
| kind*   | DMSO          | DGBE          | -             | DMAC          |
| concentration (wt %)  | 15            | 40            | -             | 15            |
| Anti-corrosion agent  |               |               |               |               |
| kind  | catechol      | catechol      | catechol      | catechol      |
| concentration (wt %)  | 3             | 3             | 5             | 3             |
| H <sub>2</sub> O  |               |               |               |               |
| concentration (wt %)  | 12            | 12            | 12            | 12            |
| Stripping conditions  |               |               |               |               |
| temperature (°C)  | 55            | 55            | 55            | 55            |
| time (min)  | 5             | 10            | 5             | 10            |
| Stripping   | A             | A             | A             | A             |
| Corrosion   | A             | A             | A             | A             |
| Note: MLAD = N-methylol acetamide<br>HEAD = N-(1-hydroxyethyl) acetamide<br>DMSO = dimethylsulfoxide<br>DGBE = diethylene glycol monobutyl ether<br>DMAC = dimethyl acetamide |               |               |               |               |

Table 4

|  | COMPARATIVE EXAMPLES |               |               |                       |
|--|----------------------|---------------|---------------|-----------------------|
|  | 1                    | 2             | 3             | 4                     |
| Amine  |                      |               |               |                       |
| kind   | ethanol amine        | ethanol amine | ethanol amine | N-methyl ethanolamine |
| concentration (wt %)   | 70                   | 78            | 65            | 78                    |
| Alkanol amide  |                      |               |               |                       |
| kind*  | -                    | -             | -             | -                     |
| concentration (wt %)   | -                    | -             | -             | -                     |
| Organic solvent  |                      |               |               |                       |
| kind*  | DMSO                 | -             | DGBE          | -                     |
| concentration (wt %)   | 30                   | -             | 15            | -                     |
| Anti-corrosion agent   |                      |               |               |                       |
| kind   | -                    | catechol      | catechol      | catechol              |
| concentration (wt %)   | -                    | 5             | 3             | 5                     |
| H <sub>2</sub> O   |                      |               |               |                       |
| concentration (wt %)   | -                    | 17            | 17            | 17                    |
| Stripping conditions   |                      |               |               |                       |
| temperature (°C)   | 55                   | 55            | 55            | 55                    |
| time (min)   | 10                   | 3             | 5             | 10                    |
| Stripping  | C                    | B             | C             | D                     |
| Corrosion  | A                    | B             | B             | A                     |
| Note: DMSO = dimethylsulfoxide<br>DGBE = diethylene glycol monobutyl ether |                      |               |               |                       |

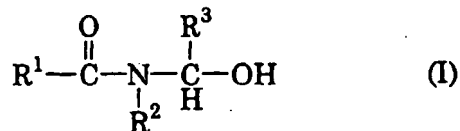
#### Industrial Applicability

[0045] By using the photoresist stripping composition of the present invention, the resist residue remaining after dry etching using a reactive gas and ashing can be quite easily removed without corroding the wiring material, etc.

#### Claims

1. A photoresist stripping composition comprising an amine compound and at least one alkanol amide compound selected from the group consisting of:

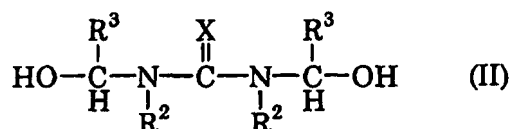
compounds represented by Formula I:



wherein R<sup>1</sup> is hydrogen, alkyl group, hydroxyalkyl group, alkenyl group, aryl group, or amino group; R<sup>2</sup> is hydrogen, alkyl group, hydroxyalkyl group, aryl group, or allyl group; R<sup>3</sup> is hydrogen, alkyl group or hydroxyalkyl group; with the proviso that R<sup>1</sup> and R<sup>2</sup> together with the amide linkage may form a ring structure when R<sup>1</sup> and R<sup>2</sup> are both alkyl groups;

polymers of the compounds of Formula I wherein R<sup>1</sup> is alkenyl group; and compounds represented by Formula II:

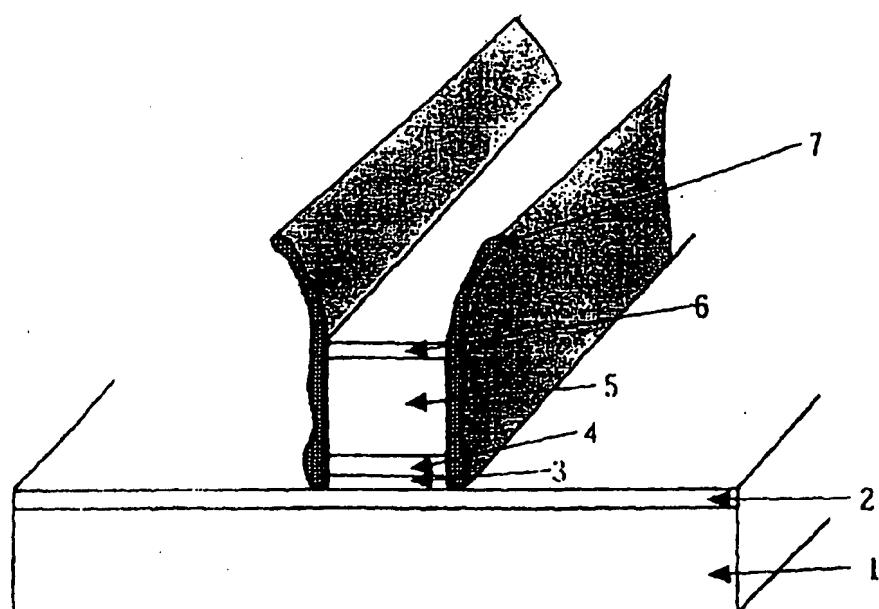




wherein R<sup>2</sup> is hydrogen, alkyl group, hydroxyalkyl group, aryl group, or allyl group; R<sup>3</sup> is hydrogen, alkyl group or hydroxyalkyl group; and X is O or S.

2. The photoresist stripping composition according to Claim 1, wherein R<sup>3</sup> of Formula I or II is hydrogen or methyl group.
3. The photoresist stripping composition according to Claim 1 or 2, wherein the alkanol amide compound is N-methylol acetamide, N-methylol formamide, N-(1-hydroxyethyl) acetamide, N-(1-hydroxyethyl) formamide, N-methylol urea, N,N'-dimethylol urea, N-methylol acrylamide, or N-methylol methacrylamide.
4. The photoresist stripping composition according to any one of Claims 1 to 3, wherein the amine compound is an alkylamine, an alkanolamine, a polyamine, a hydroxylamine compound or a cyclic amine.
5. The photoresist stripping composition according to any one of Claims 1 to 4, further comprising an organic solvent.
6. The photoresist stripping composition according to any one of Claims 1 to 5, further comprising an anti-corrosion agent.
7. The photoresist stripping composition according to Claim 6, wherein the anti-corrosion agent is an aromatic hydroxy compound.
8. The photoresist stripping composition according to Claim 7, wherein the anti-corrosion agent is catechol.
9. The photoresist stripping composition according to any one of Claims 1 to 8, further comprising water.
10. A method for producing a semiconductor element, comprising the steps of:
  - (1) coating a photoresist composition onto a wiring thin film formed on an inorganic substrate to form a photoresist film;
  - (2) patterning the photoresist film by exposure to light and subsequent development to form a photoresist pattern;
  - (3) etching non-masked portions of the wiring thin film using the photoresist pattern as a mask to obtain the inorganic substrate having formed thereon fine circuits; and
  - (4) removing the remaining photoresist pattern by contacting the inorganic substrate having formed thereon fine circuits with the photoresist stripping composition as defined in any one of Claims 1 to 9 at a temperature from ordinary temperature to 150°C.
11. A method for producing a semiconductor element, comprising the steps of:
  - (1) coating a photoresist composition onto a wiring thin film formed on an inorganic substrate to form a photoresist film;
  - (2) patterning the photoresist film by exposure to light and subsequent development to form a photoresist pattern;
  - (3) etching non-masked portions of the wiring thin film using the photoresist pattern as a mask to obtain the inorganic substrate having formed thereon fine circuits;
  - (4) subjecting the inorganic substrate having formed thereon fine circuits to ashing treatment; and
  - (5) removing the remaining photoresist pattern by contacting the inorganic substrate that is subjected to ashing treatment with the photoresist stripping composition as defined in any one of Claims 1 to 9 at a temperature from ordinary temperature to 150°C.

FIG. 1



## INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP02/06216

| <b>A. CLASSIFICATION OF SUBJECT MATTER</b><br>Int.Cl. <sup>1</sup> G03F7/42  |   |   |
|--|---|---|
| According to International Patent Classification (IPC) or to both national classification and IPC  |   |   |
| <b>B. FIELDS SEARCHED</b><br>Minimum documentation searched (classification system followed by classification symbols)<br>Int.Cl. <sup>1</sup> G03F7/42  |   |   |
| Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched<br>Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2002<br>Kokai Jitsuyo Shinan Koho 1971-2002 Toroku Jitsuyo Shinan Koho 1994-2002  |   |   |
| Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)   |   |   |
| <b>C. DOCUMENTS CONSIDERED TO BE RELEVANT</b>  |   |   |
| Category*  | Citation of document, with indication, where appropriate, of the relevant passages  | Relevant to claim No.   |
| Y  | GB 2340256 A (Samsung Electronics Co., Ltd.),<br>16 February, 2000 (16.02.00),<br>Claims 10 to 15<br>& JP 2000-199972 A & US 6274537 B1<br>& KR 172058 Y & DE 19936626 A<br>& FR 2782175 A & CN 1243971 A | 1-11  |
| Y  | JP 9-244263 A (Fuji Hanto Electronics Technology<br>Kabushiki Kaisha),<br>19 September, 1997 (19.09.97),<br>Claims; Par. Nos. [0023], [0027]<br>(Family: none)  | 1-11  |
| A  | JP 2001-22095 A (Nippon Zeon Co., Ltd.),<br>26 January, 2001 (26.01.01),<br>Claim 1; Par. No. [0011]<br>(Family: none)  | 1-11  |
| <input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C. <input type="checkbox"/> See patent family annex.   |   |   |
| * Special categories of cited documents:<br>"A" document defining the general state of the art which is not<br>considered to be of particular relevance<br>"E" earlier document but published on or after the international filing<br>date<br>"L" document which may throw doubts on priority claim(s) or which is<br>cited to establish the publication date of another citation or other<br>special reason (as specified)<br>"O" document referring to an oral disclosure, use, exhibition or other<br>means<br>"P" document published prior to the international filing date but later<br>than the priority date claimed<br>"T" later document published after the international filing date or<br>priority date and not in conflict with the application but cited to<br>understand the principle or theory underlying the invention<br>"X" document of particular relevance; the claimed invention cannot be<br>considered novel or cannot be considered to involve an inventive<br>step when the document is taken alone<br>"Y" document of particular relevance; the claimed invention cannot be<br>considered to involve an inventive step when the document is<br>combined with one or more other such documents, such<br>combination being obvious to a person skilled in the art<br>"&" document member of the same patent family |   |   |
| Date of the actual completion of the international search<br>06 September, 2002 (06.09.02)   |   | Date of mailing of the international search report<br>24 September, 2002 (24.09.02) |
| Name and mailing address of the ISA/<br>Japanese Patent Office   |   | Authorized officer  |
| Facsimile No.  |   | Telephone No.   |

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## INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP02/06216

## C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages                           | Relevant to claim No. |
|-----------|--|-----------------------|
| A         | JP 64-81949 A (Asahi Chemical Industry Co., Ltd.),<br>28 March, 1989 (28.03.89),<br>Claims<br>(Family: none) | 1-11                  |

Form PCT/ISA/210 (continuation of second sheet) (July 1998)